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INDUSTRIAL USES OF GAS.

[From a paper read by H. M. THORNTON before the Royal Society of Arts, London.]

Factories alone in Great Britain consume 66,000,000 tons of coal a year, or just over one-third of the total consumption of coal.

What does this mean in the way of wastage? If the 66,000,000 tons were carbonized in gas works, and yielded 12,500 cubic feet of gas per ton, we should have from it a total production of 825,000,000 cubic feet of gas, which, on the new Parliamentary standard of 540 B. T. U., would equal 445,000,000,000 B. T. U. It is impossible properly to grasp what such figures mean, but those billions of B. T. U. used in industrial heating are controllable, and there need be comparatively little waste in obtaining from them effective duty. With coal there is large waste of heat in combustion and in driving off those volatile constituents which are useless where high temperature and pure incandescence are required. With gaseous fuel the heat can be directed exactly as and where needed, and heat losses by radiation and otherwise can be largely prevented by proper construction and insulation.

Pursuing the point as to waste, we have our gas as the primary product, and there are the secondary ones. First, there is coke. Carbonize the 66,000,000 tons of coal in gas retorts, and we should have for sale between 10 and 11 cwt. of coke per ton of coal, a total of (say) 35,000,000 tons of smokeless fuel, with a calorific value of 13,000 to 14,000 B. T. U. per pound—over a thousand billion B. T. U. in the aggregate. Then we should produce some 10 to 11 gallons of tar per ton of coal, or 700,000,000 gallons of tar would be realized. In addition to to this there would be about 28 pounds of sulphate ammonia per ton of coal or 825,000 tons of this valuable fertilizer.

These figures show the waste that is taking place by such a large use of coal in factories.

The manufacturer has his point of view in this matter; and we have to adopt, in order to secure his examination of the question, the art of "gentle persuasion." It is necessary to show to the manufacturer that it is to his direct benefit to adopt the modern smokeless method of firing. Some of the advantages are;

(1) Economy in space occupied by appliance; necessity of smoke-stack ellminated; a practically unlimited choice of position for the furnace.

(2) No space required for storage of fuel; and no removal of ashes.

(3) Increase in output per cubic foot of factory, owing to economy of space occupied by gas furnaces in comparison with hard fuel furnaces.

(4) The constant and unvarying supply of fuel of a uniform calorific value, at a fixed rate.

(5) Labor saving—absence of stoking, storage and conveyance of fuel.

(6) Rapid and improved production, due to precise control of working temperature.

(7) In many cases a lower capital expenditure for installation.

(8) Cleanliness, which frequently is of primary importance.

As an example I will quote the experience of a large firm of spring makers that recently installed seven gas furuaces in substitution for hard fuel furnaces:

(1) They have saved two-thirds of the floor space.

(2) They save labor—to the extent of dispensing with one stoker.

(3) They secure absolute reliability and uniformity of temperature—essential in spring making.

(4) They entirely eliminate smoke and soot in the shops.

(5) Their fuel bill for coal-fired furnaces was for a year £694; the gas consumption for the same work the next was £425—a saving in fuel of £269.

It is not surprising to learn that this firm decided to abandon solid fuel entirely, and now do the whole of their work with gas furnaces—their consumption being nearly 8 million cubic feet per annum.

Another example, a firm manufacturing chronometers and nautical instruments, is also convincing:

(1) They previously used steam power; and coke for brass and gun-metal melting at a cost of £135 per annum for fuel.

(2) They now use a gas engine, and gas crucible furnaces; and their gas bill is £105 per annum.

(3) They now secure six melts per day, as against four with coke furnaces; increases their output 50%.

I will now show what an important part gas is playing in the advancement of some of our largest industries.

Deposing the Coal-Fired Boiler.—The coal-fired steam boiler still exists in numerous factories, but the gas engine is superseding it wherever its application is possible. In some factories where power is used intermittently, electric motors on individual machine are found more convenient than driving by shafting, and in such cases gas enginss are advantageously employed for generating the current.

The Bonecourt gas boiler provides means for steam raising, and is being increasingly used for this purpose.

Gas Furnaces.—It will, I think, be interesting to describe briefly some of the chief points of the principal types of furnaces.

Gas heated muffle and crucible furnaces are not new. They have been used in the laboratory for experimental purposes for many years, but those laboratory appliances did not take count of the relation of fuel consumption and time expenditure to work done, as is necessary in industrial operation. To translate the old laboratory furnace to the needs of the factory was not a mere question of proportion. It has meant hard, persistent investigation. It is now a fact that positive success has been attained in the application of town gas as a fuel for large furnaces, and down to the smallest crucible furnace for melting gold.

The oven or semi-muffle furnaces have the most extended application. They are required by almost all manufacturers in some form for annealing, reheating, case-hardening and hardening. Light or heavy work will determine whether the furnace should be of medium or maximum strength in structure; while in each case the heat generated must be produced under the most economical conditions commensurate with uniform heating. These conditions have given rise to three distinct types of furnaces:

(1) Natural draught generator oven furnace, suitable for annealing, reheating, hardening and light case-hardening.

(2) Natural draught reverberatory oven furnace, suitable for annealing heavier work and case-hardening.

(3) Low pressure gas and air oven or chamber furnace, suitable

for annealing, reheating, hardening both high speed and carbon steel, case-hardening, forging, both heavy and light work.

Each of the two first-named furnaces has its own particular field of usefulness, while the third has such a wide range of temperatures—viz., up to 1,400° C.—that it has practically universal application.

Figs. 1 and 2 show a natural draught generator oven furnace. Special high power bunsen burners are employed; the burner mouths sealed from the air at the point of entrance to the combustion chamber. Primary air is admitted to the burner in reduced proportion, while combustion is supported by preheated air entering the combustion chamber by a series of lateral air nostrils heated by radiation from the floor of the furnace. This furnace is very efficient, and particularly adapted to lighter work—for example, heat treatment of motor gears, the hardening of machine and other tools and parts made from carbon steels; the annealing of those parts, etc. The manipulation of this furnace is quite simple. Should a reducing atmosphere be desired for heat treatment of gears, etc., under non-scaling conditions, it is simply a question of reducing the air-inlets; for higher temperatures the air-ports are left open.

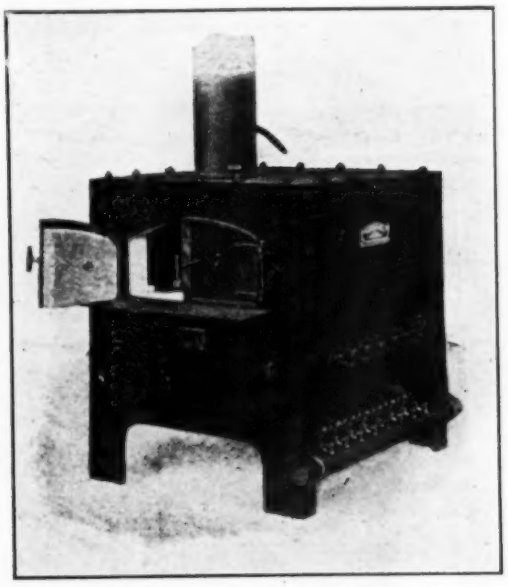


Fig. 1.—Natural Draught Generator Oven Furnace.

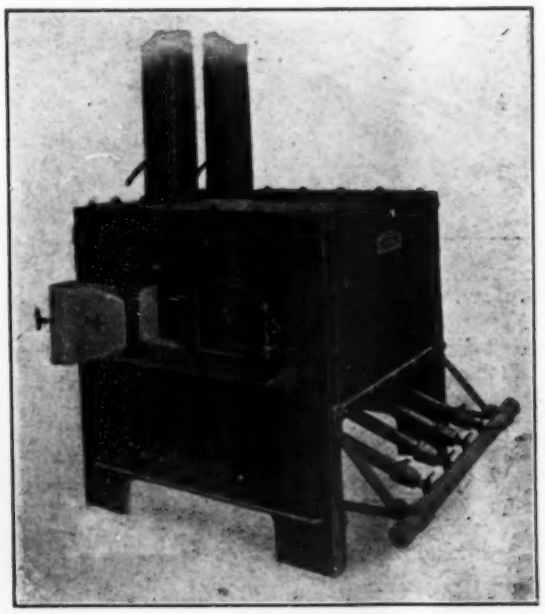


Fig. 2.—Section of Natural Draught Generator Oven Furnace.

Fig. 3 shows a natural draught reverberatory furnace. The gas enters the furnace chamber, and preheated air runs along the furnace bottom through fire-clay nostrils, and meets burners at the points where combustion takes place. The flame then passes along the underside of the furnace chamber roof, and downwards under the floor of the furnace chamber before entering the flues, which find their exit up the side of the furnace wall. It will be noticed that this furnace has no combustion chamber other than the working chamber itself. Working results prove this design of furnace to be a great success for heavier work where heats up to 950° or 1,000° C. are employed and no air blast is available.

Fig. 4 shows a low pressure gas and air furnace. Air at approximately 2 inches water gauge enters the firebrick lining at the roof of the furnace through a series of fireclay tubes, travels down the side and along the bottom of the furnace, is preheated and meets the incoming gas at the point where combustion takes place. The products of combustion then pass along the underside of the furnace roof and down under the floor, as in the case of the reverberatory furnace. An oxidising or reducing atmosphere is obtained by increasing or diminising the air pressure. Temperatures up to 1,400° C. are obtainable. This furnace is suitable for all the operations before mentioned, and can be used for baking emery wheels, firing porcelain (with muffle), heat treatment of tungsten ores, heating blanks for drop forgings. Generally speaking this furnace covers the widest number of working conditions, and is the most economical and efficient. For annealing steel bar it superceds the generator type of furnace, because it is possible to anneal under perfect conditions. The cooling process in steel annealing, which takes something over 18 hours, may be done with this furnace free from any possibility of cold air finding its way into the furnace chamber and causing scale on the work.

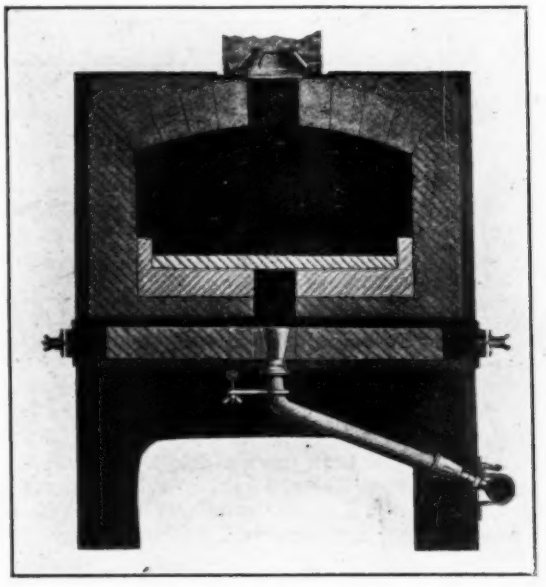


Fig. 3.—Natural Draught Reverberatory Furnace.

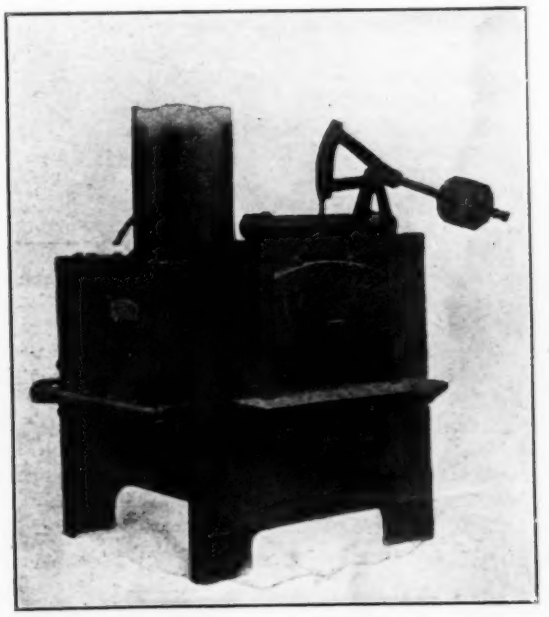


Fig. 4.—Low Pressure Gas and Air Furnace.

TYPICAL INDUSTRIAL APPLICATIONS.

Annealing.—For annealing sheet-metal stampings gas is being increasingly used, and when they are subjected to one or two heats only, a single-oven furnace serves the purpose. Some stampings have to go to the pressing or drawing machine four or five times or more, and require annealing between each operation. This is often the case with special forms of stamped or drawn nickel-silver, brass, etc. For this purpose a twin-oven furnace is preferable, the top oven being used for preheating the articles slowly before subjecting them to the full annealing temperature in the lower oven, thereby avoiding heat-cracking, which may take place when the single-oven type is used. Fig. 5 shows this apparatus.

Fig. 5.—Twin Oven Furnaces for Annealing Metal Stampings.—Soft Metal Melting Furnaces on Right.

Wire manufacturers use gas furnaces for annealing. At Cleckheaton (Yorkshire) the wire industry is responsible for a large portion of the 45,000,000 cubic feet of gas consumed per annum for industrial purposes. The heavier grades of wire are usually annealed by hard fuel, gas-jets being used at the entrance of the heated chamber to prevent the admission of air and consequent scaling of the wire.

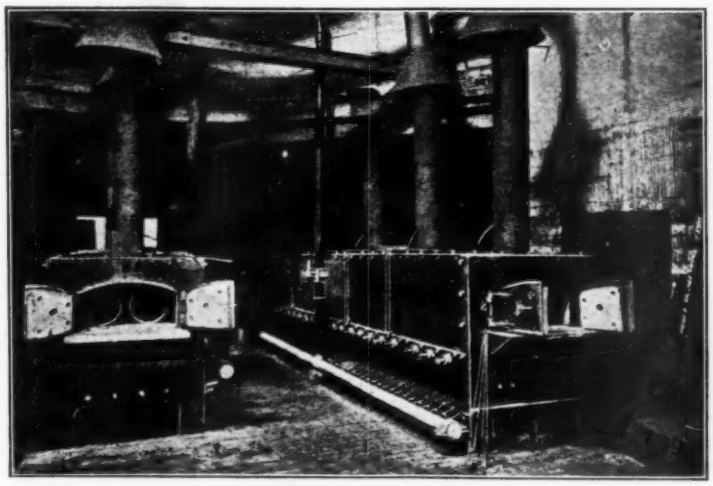


Fig. 6.—Two 16-Foot Steel Bar Annealing Furnaces of Regenerative Type.

Gas furnaces are also employed for annealing steel tubes, and for softening the ends of steel studs used in motor and cycle chain making. Steel pens, gun barrels and breeches, motor cylinders prior to repairing by the oxy-acetylene process, and many other articles are also annealed by gas.

Manufactured steel, in bars, is sent out by the makers annealed, and for this purpose gas furnaces are being increasingly used. Fig. 6 illustrates two steel bar annealing furnaces that consume gas on a fairly large scale. Annealing in coal furnaces necessitates packing the bars in a heavy cast-iron box to prevent scaling. This box is considered by some to be unnecessary in the gas furnace, in view of the uniform conditions under which gas furnaces work. Eliminating the box naturally means less absorption of heat. Decreased labor is also an important factor—in short, gas annealing has proved very economical. In many of the smaller steel works, where annealing is intermittent, the saving by the use of gas furnaces is something like 50% in the cost of fuel alone.

The following are figures from actual working:

Annealing Steel in Richmond Regenerative Gas Oven Furnace.

	Carbon Steel.	High-speed Steel.
Weight of charge	35 cwt.	45 cwt.
Total time of heating	6 hours	9 hours
Time of cooling	42 "	40 "
Total time of operation	48 "	49 "
Maximum temperature attained	880°C.	875°C.
Gas consumption per ton of steel	3,600 cubic feet	5,000 cubic feet
Cost of gas per ton of steel annealed with gas at 1s .6d per 1,000	5s. 5d.	7s. 6d.

Following the progress of the steel bar to the manufacturer of tools, gear-parts, mining and agricultural implements, cutlery, ordnance materials, electrical appliances and the manifold component parts of machinery, we come to the processes of hardening, case-hardening, and tempering.

Hardening.—This process is the one whereby steel is converted into its hardest state, by being subjected to heat and quickly quenched to a low temperature, either by means of liquid, or by air blast.

Case-hardening is the method of converting mild steel, which will not harden direct, into a steel which will harden glass-hard on the surface when quenched in water, leaving a soft core in the centre of the bar; making practically an almost unbreakable steel. This steel is suitable for gear wheels, cam shafts, bicycle and motor parts. After the carburizing process is complete, the steel article is subjected to a hardening process, which varies according to the different methods in vogue, and is generally known as the "thermo treatment" of steel. For all these operations gas oven furnaces are being increasingly used.

Tempering is the process of heating up hand and machine tools, gearings, etc., to the temperature which is known to give temper to the steel. The operation is carried out in two ways—tempering by color, or by temperature. Razors, shear blades, saws, and articles of a kindred nature are frequently tempered by color on an open or a covered heating plate. Tempering by color of smaller articles is generally done in rotary furnaces.

Tempering by temperature without color is done in furnaces containing oil, fat, lead or salt baths.

Gas and the Productions of Munitions of War.—At this critical time in our national history, those of us in the gas industry are naturally gratified at the wide extent to which gas is used in the production of armament and ammunition.

For instance, the heat treatment of shells is largely carried out by the use of gas furnaces; and the extension of their use in this direction is a matter of daily occurrence. One furnace recently supplied to an armament firm holds, at one charge, eleven of the largest naval armor-piercing shells—each shell weighing over 1 ton.

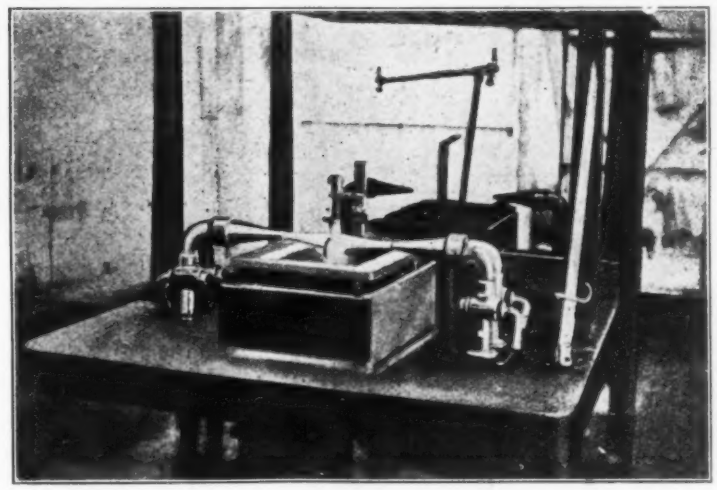


Fig. 7.—Welding Bayonet Handles to Blades.

A further instance of the national value of gas in fitting out our Army is seen in Fig. 7, showing the heating equipment used in welding bayonet handles to their blades.

Fig. 8 shows part of the hardening shop of an important works. Here, all the furnaces use gas as fuel; and, since the war started additional ones have heen installed, greatly assisting the output of gear parts, etc., for transport and other vehicles. There are also quite a few manufacturers who, finding the demand for their usual

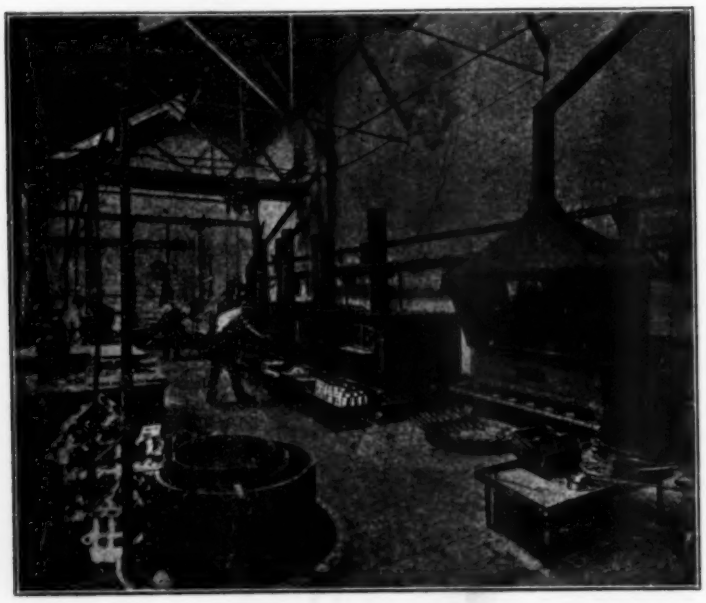


Fig. 8.—Part of the Hardening Shop of Motor and Engineering Works.

commodities considerably lessened, have been enterprising enough to adapt themselves to the special demands of the present. This conversion of old and the initiation of new industries have been going on to a larger extent than is generally known; and to the availability of gas and its elasticity in application is due the possibility of making these developments, and of making them so promptly. Any number of gas fired furnaces for any kind of heat treatment can be installed; the gas and, if necessary, the air blast can be connected in a few hours; and the new class of work can be inaugurated at once. To give only one example, a company manufacturing musical instruments found the demand somewhat lessened. Fig. 9 shows gas furnaces that were ordered and installed in a few days, and the shop has been transformed into an important adjunct to our army supplies. The operation shown is the tempering and coloring of steel cartridge clips; each furnace dealing with about 10,000 clips a day.

Fig. 9.—Gas Oven Furnaces for Tempering and Coloring Cartridge Clips.

Another instance of how gas has served during war time is in air craft factories, where gas furnaces are used continuously both in the Government and private works. Unfortunately I have not been allowed to photograph any of these factories.

The Heat-Treatment of Metallic Ores.—This is an industry which has been largely developed in Germany, and since the outbreak of war energetically taken up in this country. These ores, which form alloys for special steels, are heat treated in high temperature gas heated oven furnaces, and roasted at lower temperatures in a similar type of oven.

Metal Melting.—The applications of gas for metal melting are practically unlimited. It is used by gold refiners, jewelry manufacturers, goldsmiths and silversmiths—in fact, wherever precious metal is melted gas is the most satisfactory fuel. The melting of brass, aluminum and other alloy metals is an important opening for the application of gas heated crucible furnaces.

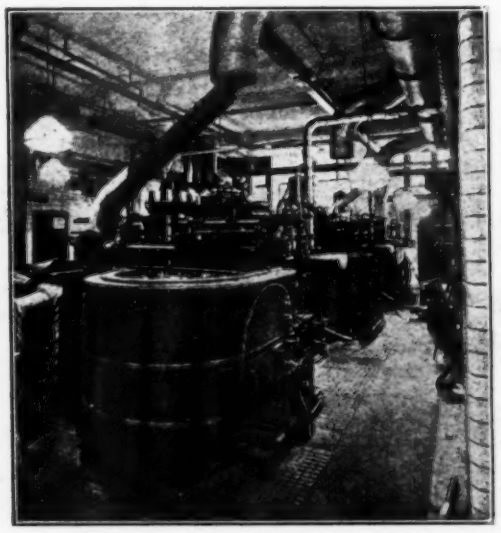


Fig. 10.—Lead Melting Furnaces at "Lloyd's Newspaper."

Lead and metal melting is found in many industries. One of the chief and most familiar trades to which gas for lead melting can be applied is the printing trade.

In every town the printing trade is represented in some form or other. The typefounder requires a lead melting furnace, the stereotyper also, and the general melting of metal for composing machines is a daily process in large printing offices. Fig. 10 shows Lloyd's newspaper type foundry with lead melting furnaces.

An "internal" heater, suitable for melting soft metal, boiling liquids, etc., has recently been introduced. It is immersed in the metal or liquid, and therefore the proportion of heat utilized is greater than if the burners are beneath the tank in the ordinary way. One operation for which this is used is the heating of vats containing 200 gallons of cold water, in which bones are steeped for about 4 hours; after which the gas is lit, and the hot water cleanses the bones and extracts the marrow. The method previously employed was to inject steam into the vats; and owing to their being of wood, any ordinary method of gas heating would have been difficult.

Varnish Making.—Gas boilers for making varnish are being installed in preference to coal, and have proven quicker and cheaper.

The results in one instance were as folllows: With coal firing, the time was 6 hours, and a coal consumption of 2½ cwt. at a cost of 1s. 4½d. With gas firing, the time was 2½ hours with a high power burner consuming 150 cubic feet per hour. The approximate expenditure was 8½d, exclusive of labor, with the advantage of increased production and safety from fire.

Brazing, Blow Pipe and Soldering Work.—For brazing, blow pipes with gas and air blast or high pressure gas are extensively used. Marine engine works and copper tube works have been brazing flanges on copper pipes with hard fuel furnaces; but recently some of them have been persuaded to use gas. The advantage is that the metal and flux are kept clean and free from particles of dust, and, therefore, a better joint is made.

Recently a new brazing method came to my notice. An engineer associated with the Indian railways has introduced a new material in connection with which he advocates the use of town gas. Heavy castings, such as large cog-wheels and embossing presses that have been fractured, have been successfully repaired with his brazing material by the use of gas blow pipes.

Blow-pipe work has many applications other than brazing. For instance, electric lamp bulbs are sealed by gas. Another electrical firm uses soldering irons in the manufacture of armatures.

A large factory in the east end of London, that produces about 14,000,000 pins per annum, uses 50 gas soldering-iron stoves and

several gas-heated machines for spreading rubber rings to make joints for "decorative work"—i. e., tins with enameled exteriors to contain liquid, paint, foodstuffs, etc.

Assaying.—In all metallurgical laboratories, chemical laboratories, research departments of public companies, and also by analytical chemists, we find useful work for gas.

The Metallurgical Laboratory of the Birmingham Municipal Technical Schools is fitted with gas muffle furnaces. In the assaying laboratory of the Heriot-Watt College, Edinburgh, one of the best equipped institutions in the country, there are gas furnaces for experimental and demonstration work.

Enameling.—In enameling on metal, china, and pottery, and gilding glassware, gas is used most successfully. Fig. 11 shows the process of jewelry enameling; the same kind of muffle can be used for all kinds of enameling on metal.

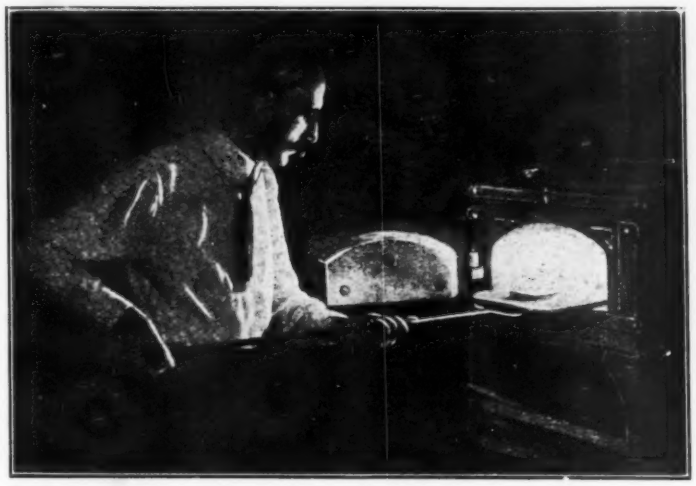


Fig. 11.—Firing Enamels on Jewelry Muffle Furnace.

Japanning.—As examples of the extended use of japanning ovens, I might mention the cycle, bedstead, gas-stove, fire-grate, electrical, tin-ware, brass hollow-ware trades, and many others.

Steam.—Fig. 12 shows a gas steam generator for heating printing presses.

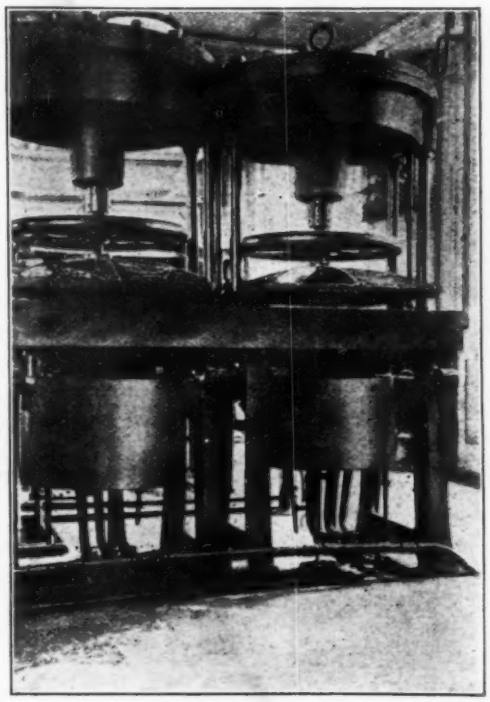


Fig. 12.—Gas Steam Generators, Heating Printers' Presses.

Steam is also required in bending and shaping cardboard, wood, umbrella handles, walking-sticks, and other similar articles. Gas is used, and could be universally and economically employed in all these processes.

Glassware Industries.—Quite recently there has been a distinct movement in the adoption of gas for heating operations in the manufacture of glassware, and the further growth of this trade will be considerably advanced by the aid of gas. During the operation of glass-blowing, the glass requires reheating to maintain it in a plastic condition. For this purpose gas furnaces, called "glory holes," are now used. These furnaces are also used for obtaining a good finished surface on moulded glassware. Fig. 13 shows two in operation. As soon as the glass-blower has finished his work on the article, it is transferred, hot, to a low-temperature furnace to allow gradual cooling. In some of the modern glassworks the furnace for cooling down is of the Lehr type. These furnaces are

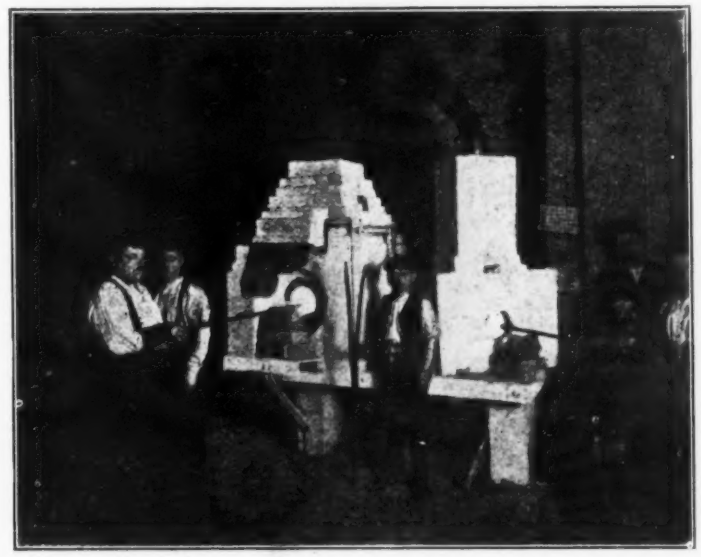


Fig. 13.—"Glory Hole" Furnaces for Heating and Re-heating Glassware during Forming and Finishing.

from 40 to 70 feet long, and about one-fourth of the length is heated by gas. The hot gases from this portion of the furnace travel through the remaining length, giving a graduated heat. The articles are placed in the warm end of the furnace and travel slowly towards the cool end, carried on rectangular iron trays drawn along 2 feet every 30 to 60 minutes, according to the class of work.

In the stained-glass trade, gas kilns are used. The colors are painted on the glass, the glass placed on a trolley and wheeled into the kilns, the firing taking from 30 to 60 minutes.

Sugar Melting.—Over 350,000 tons of sugar are melted annually in this country for making jam and confectionery, and gas is coming to the front in this, and results can be obtained with it that should insure a much more general use in small factories.

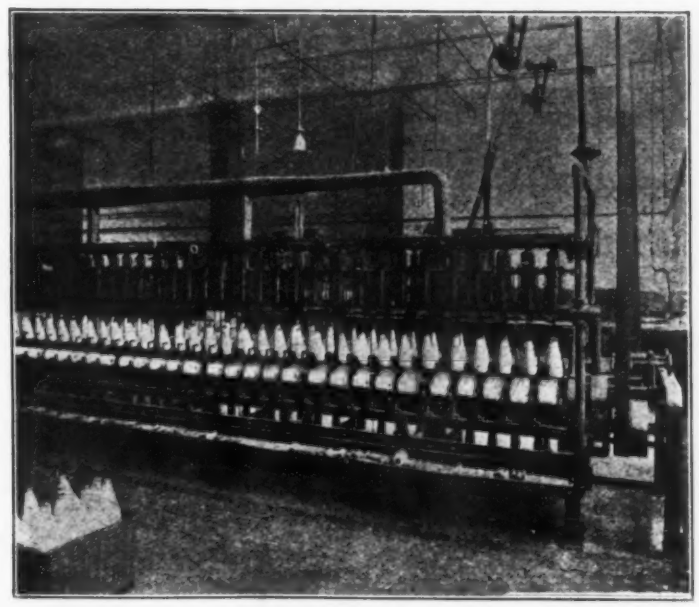


Fig. 14.—Thread-singeing Machine for Removing Single Threads or Strands.

Cotton.—Fig. 14 shows how gas is used for thread-singeing. The thread is automatically wound off a bobbin, and passed through a naked gas flame to another bobbin at the rate of 200 yards per

minute, the single threads or strands being burnt off in the process.

The machine shown will use about 300 cubic feet of gas per hour; and it will, therefore, be understood how great is the consumption of gas in this one industry.

Cloth Industry.—In Fig. 15 we see cloth being singed. This process consists in burning off all the nap and loose threads. It is the first stage in the preparation of the cloth for bleaching, dyeing and finishing, and in this way the surface of the cloth is prepared for the various finishes which it is desired to obtain, and made suitable for being printed upon. The cloth is passed over gas burners at a speed of from 80 to 200 yards a minute, according to the class of goods, and is then run through water to extinguish sparks, and is left wet until it undergoes the subsequent operations of bleaching or scouring. The consumption of a single burner machine, with ordinary width cloth, is from 200 to 250 cubic feet per hour.

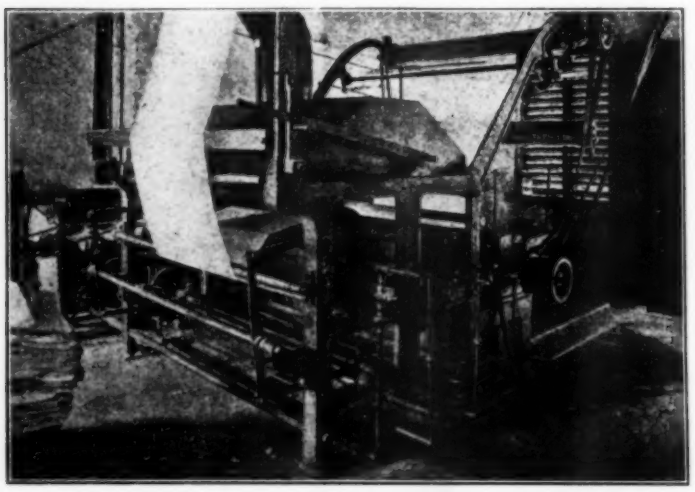


Fig. 15.—Cloth-singeing Machine for Removing Nap and Loose Threads.

Tentering is the stretching of the cloth. It is first moistened by being passed through or over a steaming chamber or damping box; then clipped at each side, stretched, and passed through the machine at an average speed of 40 yards per minute. In its passage it passes over a copper sheet heated by gas which drives the steam and moisture out of the cloth.

Hat Trade.—In making felt and silk hats, gas can be used from start to finish—shellac for stiffening, pressers for shaping, burners for singeing, irons for velouring. Fig. 16 is an illustration of a London factory turning out daily 4,500 peak caps for soldiers. On the right hand is a battery of thirty-six irons heated by gas, while the steam blocks on which the caps are shaped are heated by gas burners.

Fig. 16.—Making Peak Caps for His Majesty's Forces.

Boot Trade.—The boot trade is dependent upon gas in several of its processes. Specially designed gas heated apparatus is used for drying the cement used for "blocking" toe-caps. It is a revolving table, in the centre of which is a metal chamber heated by gas. Holes are cut to allow the toe-caps of the boots to enter in order that the cement may be quickly dried.

Gas is also used for "ironing" (that is to say, finishing off the boots by ironing the surface of the leather) and "treeing" (that is, making the boots take the exact shape of the last). The gas is supplied to the centre of the apparatus; and the irons are heated within arm's length of the ironers, so that no time is wasted in passing to and from a stove.

Gas is employed for heating the irons for polishing the heels and soles of the boots and shoes, One large boot factory uses gas entirely for power, lighting and manufacturing purposes.

The illustrations shown are but a very few of the many—the thousand-and-one—applications that have already been made of gas in manufacturing processes.

Logical Gas Rates.

[From Factors in Rate Making by A. S. IVES, in *Electrical World*.]

It is rather remarkable that in spite of widespread interest in electric rate analysis, so little has been done in developing logical gas rates. Nearly all gas rates are of the character of 25 years ago, namely, "straight" metered rates per 1,000 cubic feet with a uniform cash discount for prompt payment, or occasionally a graded discount which produces the equivalent of a "stepped" metered rate.

Recently it has been suggested that a gas load-factor rate could be adopted, and the suggestion has aroused considerable interest. The "storage" argument does not apply, but in the gas business, as in the electric, the total investment required is several times the gross annual revenue; it takes 3, 4, 5 years or sometimes more for a gas company to turn over its capital, instead of 3 or 4 months, as in the case of, for example, department stores.

Since investment or fixed charges are so large a proportion of total costs, it is proper that gas as well as electric companies should prorate such charges according to the consumer's demand. This can be accomplished by the rate system described for electric service, and the analysis would be along corresponding lines. Such a rate would enable gas companies to secure long-hour industrial business in competition with low grade oils, which cannot be touched under the present system. In developing new uses for gas, rates based on increment cost may be justified. For small consumers and for temporary service an alternate straight metered rate will be necessary. Rates may be developed similarly to the electric rates described.

There is one further detail which does not apply to the electric rate system but may be considered for gas rates. The commercial unit, 1,000 cubic feet, is comparatively large, and there are many consumers whose monthly use is 100 cubic feet or 200 cubic feet, giving, at $1 per 1,000 cubic feet, a bill of 10 cents or 20 cents. Owing to long established use of illuminating gas and the high efficiency of mantle lights of the Welsbach type, there are large numbers of such "fractional" consumers, and the "dollar minimum" usually applied for electric service would be a hardship and tend to reduce gas consumption.

A compromise sliding-scale rate is suggested for fractional consumption (less than 1,000 cubic feet per month) which will have many possible advantages, of which the following (for a base rate of $1) would be an example:

Sliding-Rate Scale for Small Gas Consumers.

Cubic Feet.	Total Charge.	Cubic Feet.	Total Charge.
100	$0.25	600	$0.78
200	0.40	700	0.85
300	0.51	800	0.91
400	0.61	900	0.96
500	0.70	1,000	1.00

Where the base rate is more or less than $1 the sliding-scale would be proportional. Such a method shows the small consumer, at once, the advantage of becoming a larger consumer, as each successive 100 cubic feet costs less and lowers his average rate. This gradually educates him to a better understanding of the principle of load-factor rates. The company benefits by a return more nearly proportional to cost of service.

THE IMPROVED JONES OIL GAS PROCESS AT THE POTRERO GAS WORKS, SAN FRANCISCO.

[From description by E. C. and L. B. JONES in Pacific Service Magazine.]

The study of converting petroleum into a fixed illuminating gas has been like a pilgrimage into an unknown country, where the trail is blazed to make it easy for others to follow but not to facilitate a return journey. For, unlike the laboratory experiments which are the forerunners of most research work, the development of oil gas manufacture has been along practical lines in large generators actually producing gas for city consumption with never a thought of failure.

When we stop to consider the nature of petroleum, the crude material used both for heating the generators and making gas, the work seems like unraveling sunlight to produce rainbows, and then further dissecting the primary colors of the spectra into the myriads of shades and tones of color. If we examine a drop of petroleum it seems to be nothing but a brown viscous fluid with a slightly aromatic odor, and yet this simple drop of oil has been a puzzle to the scientific world since it first seeped out of the ground and was given a Greek name which means "rock oil."

Three different opinions as to the origin of petroleum exist among scientific authorities. Geologists firmly believe in its organic origin from vegetable matter, while about an equal number feel sure that, while it had its beginning in organic substances, the material was animal marine organisms, and small quantities of petroleum are said to have actually been produced from diatomaceous deposits found in the sea.

The chemical theory of inorganic origin is held by some of the world's brightest minds, notably the great chemist Berthelot, who believed in an instantaneous chemical reaction between carbon and hydrogen. This he conceived could occur if an intensely heated metallic kernal in the earth were brought in contact with carbonic acid and water, thus producing the various compounds of carbon and hydrogen found in petroleum. This theory seems to have been strengthened by the comparative recent discovery of the method of obtaining acetylene gas by the action of water on calcium carbide. Still geologists and chemists are each happy in their denominational beliefs, and are safely entrenched behind the fact that no one is sure of the true origin of petroleum, nor is the mystery likely to be solved.

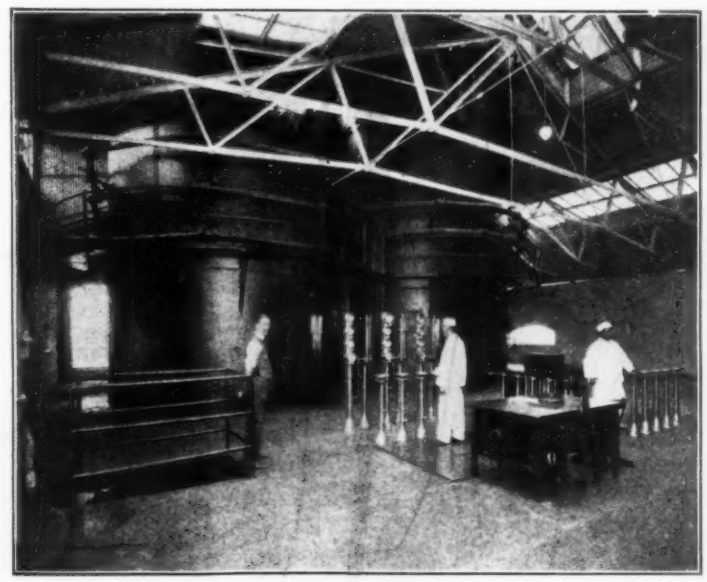
This wonderful substance, with its obscure origin, is still more mysterious in its marvelous combinations of carbon and hydrogen, almost without number and little understood. There are about thirty-nine saturated hydrocarbons appearing in California petroleum, whose chemical formulas extend from C_6H_{12} to $C_{28}H_{58}$, and in the nomenclature of chemistry are given names containing from six to twenty-two letters.

This most complex liquid when exposed to heat assumes new combinations of carbon and hydrogen for nearly every degree of heat applied to it, and it is only quite recently that any attempt has been made to regulate the composition of oil gas. The first oil gas was made in retorts originally intended for the distillation of coal, the only difference being a series of wrought-iron pipes supported within the retorts for increasing the surface from which heat was applied to the oil, and extending the time of contact of the oil with the heated surfaces. It is apparent that the temperature under which the oil was distilled must have been low, in fact a dull cherry red, because the iron pipes would soften and sag out of shape at a higher temperature. The gas produced in this way from oil was heavy and unstable, high in candle power, and if burned alone it was necessary to use small burner tips to avoid a smoky flame. It was rich in hydrocarbons, which furnish what is known as candle power to the flame; but it was so rich in these elements, and so poor in heating gases, that the flame temperature was low and the candle power was not developed. The chief use of this kind of oil gas was for raising the candle power of coal gas, and its manufacture was usually an auxiliary to a coal gas works. The only by-product of oil gas made in this way is a small quantity of oil tar. The difficulties encountered in the making and burning of retort oil gas established a prejudice against it in the minds of gas men, and as the wonderful developments in the manufacture of ideal illuminating gas from oil were made in California, this prejudice still exists in the minds of those who are not fortunate enough to live in California. As a pendulum swings from one side to the other, so the next step in oil gas manufacture went to the extreme of high and destructive heats.

Retorts externally heated were discarded, and generators heated internally by oil fuel substituted. This was a decided improvement in the method of making gas, but in the effort to overcome all the faults of retort oil gas, the oil was subjected to temperatures in the checker brick of the generators which broke down the hydrocarbons in the gas into lower groups, with a separation of free hydrogen and carbon. The gas thus produced contained over 60% of hydrogen, which is a heating gas very much overrated because its thermal value is usually stated by weight and it is the lightest known gas. In the gas business all gases are measured by volume and the cubic foot is the unit. While a pound of hydrogen contains 62,100 B. T. U., a cubic foot contains but 344, or only 1 B. T. U. more than carbon monoxide.

Intense and badly applied heats in oil gas generators break the bonds between carbon and hydrogen, and the carbon liberated appears in the form of finely divided powder known as lampblack, which passes out of the generators in suspension in the gas, and is recovered by washing the gas with water in the washbox.

Previous to the introduction of the Improved Oil Gas Process, 30 pounds of lampblack per 1,000 feet of gas was considered economical operation; but when we think that lampblack is made from the same oil from which gas is made, and that the oil weighs 8.1 pounds per gallon, it is obvious that much oil is wasted in producing lampblack. The lampblack collected with the water from the washbox, is used as fuel for making steam in gas works; but the quantity produced so greatly exceeds the need for this purpose that many of the larger gas companies dry the lampblack and press it into carbon briquettes for domestic fuel. This disposal of a residual product entails the employment of fuel and labor in drying, labor and material for making briquettes, and sacking and delivering them to the customers. The cost of this work, together with the expenses incurred in advertising, canvassing and bookkeeping is considerable, so that when briquettes are sold at $9 a ton delivered, it is not all profit, even if the crude lampblack is given no value.



Operating Floor Showing No. 5 Generator.

In the Improved Jones Oil Gas Process the lampblack produced is almost negligible, usually not more than 4 or 5 pounds to 1,000 cubic feet of gas—not enough to provide boiler fuel for the operation of the works. The question naturally arises; what becomes of the lampblack?

In the new process the oil is treated in a scientific manner, the *heat accidents* that form lampblack do not occur, and the oil is made into merchantable illuminating gas instead of the hydrogen and lampblack. It will be seen that this is real economy in operation when we consider that the oil formerly destroyed to

(*Continued on page 26.*)

DEATH OF MRS. A. M. CALLENDER.

It is with deep sorrow that we announce the death of Mrs. A. M. Callender, on July 6th, at her home in New York City.

Mrs. Callender became the Senior member of the firm of A. M. Callender & Co., publishers of the AMERICAN GAS LIGHT JOURNAL, upon the death of her husband Mills L. Callender in 1871 ; and since 1913 when the business was incorporated, has been its Vice-President and Treasurer.

For more than forty years Mrs. Callender has been in touch with gas matters, and is personally well known to all the older generation of gas men.

Her life was bound up in the JOURNAL. Being deeply interested in welfare movements she gave freely of her time and purse, and by a long, active and fruitful life her eternal rest is well earned.

Mrs. Callender was of the Swain family of Nantucket, Mass., and a direct descendant of Tristam Coffin. She leaves one son, Elbert P. Callender, President of the AMERICAN GAS LIGHT JOURNAL, Inc.

Her funeral was on Thursday July 8th, interment being at Kingston, N. Y., where her husband is buried.

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SANFORD K. CAMPBELL, Editor.

NEW YORK, MONDAY, JULY 12, 1915.

For a Central Testing Laboratory.

The Central Development Committee of the National Commercial Gas Association, since recommending in its 1914 report the establishment of a central testing laboratory for the gas industry, has continued its inquiries along this line and has asked the co-operation of the Institute in canvassing the matter.

Briefly, the proposition contemplates the establishment of a central testing laboratory to test appliances and materials used by gas companies, and it would be able to undertake research work for individuals or companies or for associations, or on its own initiative. Such a laboratory would provide many advantages.

It could furnish authoritative information and make tests covering the design, construction and operation of appliances, and reports on materials, instruments, etc.

It would eliminate the present very serious duplication going on all over the country, which affects not only those making tests of appliances and materials, but also the manufacturers submitting the articles, who are now obliged to send their wares first to this company and then to that.

Such a laboratory would be of material help in raising the standard of appliances generally, as it would become increasingly difficult for the manufacturer of inferior articles to dispose of them. It should not, of course, be intended to exercise any direct authority, but the mere drawing up of authoriatative and impartial reports would tend materially to crystallize the ideas of the various gas companies as to what was proper to purchase. It should not make recommendations in its reports unless specifically requested by a company or individual ordering a confidential report.

It would be an important factor in helping on the good work of standardizing construction, etc., and there is room for a good deal of improvement without interfering with the skill and initiative of individual manufacturers.

Such a service would save a vast amount of time at present wasted by gas men generally in interviewing individvals with new ideas, patents, appliances, etc., which they want to market. They could be referred to the Central Laboratory for attention and advice; and it would be possible and proper for the gas man to ask for the laboratory's report on the subject.

It might eventually work out as a clearing house of such ideas and inventions, and might assist in getting worthy inventors in touch with capital.

The plan for financing the laboratory would have to be worked out. A possible solution would be support by sustaining or contributing member companies, who might be stockholders if that proves desirable, who would pay fixed sums proportionate to their importance in the gas field, and in addition, for reports made for them. Reports or tests to non-members would naturally be on an increased scale of rates.

All of the details would, of course, have to be worked-out, possibly on different lines from those indicated, but the general scheme is worthy of serious consideration, and properly administered such a central authority would be of inestimable value to the gas industry.

N. C. G. A. Membership Campaign.

The campaign for new members started by the Membership Committee of the National Commercial Gas Association is bringing encouraging results. The Honor Roll as of July 1st shows this ranking of those active in getting new members:

Name and Company Connection.	Points Secured
Sidney Curren, Public Service Gas Co., Newark, N. J.	240
R. G. Munroe, Denver Gas and Electric Light Co., Denver, Col.	90
J. B. Myers, The United Gas Improvement Co., Philadelphia, Pa.	62½
W. W. Barnes, Bayley & Sons, New York, N. Y.	55
H.W. Hunter, Baltimore Gas Appliance & Mfg. Co., Balto, Md.	45
A. H. Glendinning, Public Service Gas Co., Bayonne, N. J.	45
Otto Reiner, Public Service Gas Co., Newark, N. J.	35
C. Zander, Public Service Gas Co., Montclair, N. J.	30
H. S. Lawton, Public Service Gas Co., Camden, N. J	30
R. I. Wilson, Public Service Gas Co., Paterson, N. J.	25
J. F. Adams, Adams Bros. Mfg. Co., Pittsburgh, Pa	25
F. S. Breeze, Public Service Gas Co., Montclair, N. J	25
W. H. Pettes, Public Service Gas Co., Newark, N. J.	20
W. F. Thomas, Public Service Gas Co., New Brunswick, N. J.	20
W. H. Bradley, Springfield Gas Light Co., Springfield, Mass.	20
C. W. Hough, J. G. White & Co., Ltd., London, England	20
R. E. Dallas, The United Gas Improvement Co., Phila., Pa.	15
H. H. Newman, Public Service Gas Co., Passaic, N. J.	15
C. M. Cohn, Cons'd Gas, Electric Light & Power Co., Baltimore	15
W. J. Clark, West chester Lighting Co., Mt. Vernon, N. Y.	12½
L. F. Blyler, Minneapolis Gas Light Co., Minneapolis, Minn.	10
W. B. Nichols, Citizens' Gas Light Co., Quincy, Mass.	10
J. H. Keppelman, Consumers' Gas Co., Reading, Pa	10
F. G. Howe, Jr., Citizens' Gas Light Co., Quincy, Mass.	10
J. P. Hanlan, Public Service Gas Co., Newark, N J	10

The Exposition of Chemical Industries.

The National Exposition of Chemical Industries, which will be held in New York City during the week of September 20th, is the first comprehensive effort made in this direction in America, although similar expositions have been held in the past at various places on the continent of Europe, and invariably with great success.

Expositions of special industries, devoted to the promotion of their interest and exchange of ideas, are most effective; and this will be for all the chemical and chemical engineering industries, where gas will be represented by new processes and novel uses.

By demonstrations manufacturers can awaken the men in the industries to their possibilities, to the products, processes and apparatus made in America; it will educate the general public to the great debt they owe to chemical achievements; and will be instructive to the legislators of the United States, and there is expectation that more intelligent and better legislation may be inspired, if not resulting immediately.

It will bring financiers to a fuller realization of the possibilities of chemical inventions, and contribute to an exchange of ideas between research and applied technologists.

No progressive technical man should neglect the opportunity presented for comparing the various products, processes and apparatus exhibited, and which bear such immediate relation to the income and status of himself and his industry.

(*Continued from page 23.*)

The Improved Jones Oil Gas Process at the Potrero Gas Works, San Francisco.

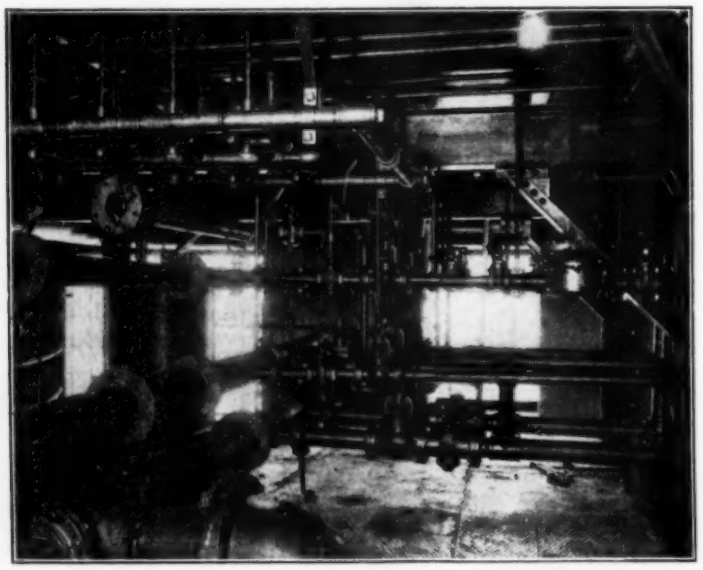
make lampblack briquettes selling in a manufactured state for $9 a ton, is now, by the new process, made into gas that weighs 32.75 pounds per 1,000 cubic feet, and at 80 cents per 1,000 is worth $48.85 per ton.

Shortly after the patents were issued for this new process, the Pacific Gas and Electric Company began the erection of two generating sets in an unoccupied brick building at the Potrero Gas Works, San Francisco. The sets were completed and put into commission May 3, 1915, when Mr. John A. Britton, Vice-President and General Manager of the Company, operated the machinery which heats the sets and turned the oil into the generators to make the first gas. These generating sets (known as Nos. 5 and 6) are the largest oil gas units in the world. They consist of two steel shells 18 feet 9 inches in diameter; the first, known as the primary, is 49 feet high, and the secondary is 63 feet high. The shells are connected at the bottom by a throat-piece, and are equipped with blast pipes, stack valves and other necessary accessories. The generators are lined with fire brick and filled with checker brick as shown in the section illustration.

Oil gas making is an intermittent process consisting of a heating period and a making period usually of 10 minutes each.

The checker brick are fire brick placed on edge, and so arranged in alternate courses that, looking down upon them, they have the appearance of a checker board. These bricks are first heated by burning oil among them, and they act as heat reservoirs, subsequently giving up the heat to decompose oil during the gas making period.

The unique features of the Improved Process are the extra chambers in the upper part of each generator shell. The chamber in the primary shell is used as an initial combustion chamber where the oil is burned for heating the entire set, thus avoiding local overheating and incandescent spots in the gas making portions of the set. The chambers are also used for superheating steam, which plays an important part in the making of improved oil gas. These chambers are intensely hot and well able to withstand the shock of instantly raising the temperature of steam from 353° F. to about 1,900° F., thus leaving the gas-making chambers at a uniform gas-making temperature.



Mezzanine Floor of the Potrero Station, showing Pipe Connections to the Controls on the Floor above.

Probably the most vital and important feature of the new process is the use of a hydrogen atmosphere in which the oil is dissociated. In the old process the oil for making gas was sprayed into heated chambers filled with checker brick, and dissociated in an atmosphere of products of previous combustion, steam in the process of superheating and the vapor of oil.

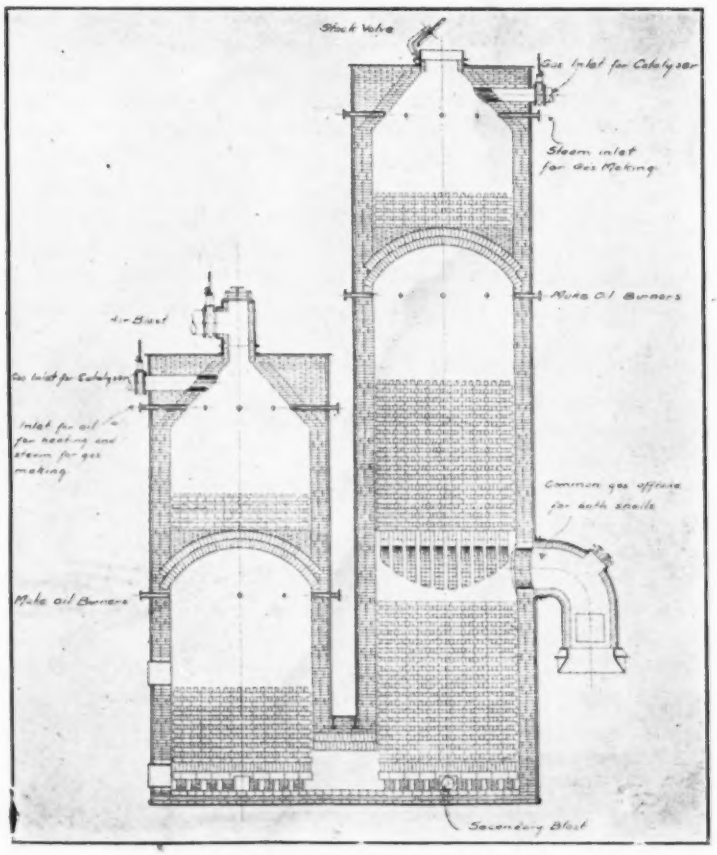
While seeking a reason for the destruction of oil into hydrogen and lampblack, it was discovered that if the oil were dissociated in an atmosphere of hydrogen the destructive breaking down of hydrocarbons ceased and the oxygen of steam combined actively with carbon to form carbon monoxide. Experiments proved that the most convenient form of this active or catalytic gas was the oil gas previously made, and to accomplish the desired results the gas-making chambers in the new generators are filled with gas at the beginning of each gas-making period and gas is admitted with the oil throughout the period. The quantity of gas required to furnish this protective catalytic atmosphere is about ten cubic feet to each gallon of oil used. By the use of this gas the formation of lampblack almost ceases, and methane, or marsh gas, is produced synthetically.

The catalytic gas is taken from the gas-holder and forced into the generator under high pressure. It might seem to be wasteful to use a finished product to assist the conversion of crude materials, but such is not the case. While the illuminants of the catalytic gas are broken down, not a heat unit is lost, so that the gas is transformed without loss of heating value. High-pressure gas is also used for injecting oil into the generators during the making period in place of steam, which had been heretofore used. This innovation carries out the plan of the process of breaking up oil in the presence of hydrogen, and prevents the formation of lampblack.

The gas made by the new process is superior to the old oil gas, and there is no difficulty in maintaining a uniform heating value of over 600 B. T. U's per cubic foot.

The chemical composition of the gas is also different, inasmuch as the methane content is considerably higher. Analyses of the new gas show 38.3% hydrogen and 48.9 methane, an improvement better appreciated when we consider that every cubic foot of methane contains three times as many B. T. U's as either hydrogen or carbon monoxide. Heating value is now the recognized standard of value of gas, for the reason that every modern gas appliance depends solely on the heat of the gas to produce light or to perform work as fuel. Candle-power of gas was only useful during the reign of open-flame burners, and it is fast becoming obsolete. A gas of high heating value and low candle-power is more efficient and economical for every purpose for which gas is used, and the nuisances of clogged burners, smoky ceilings and naphthalene stoppages are eliminated.

The improved generating sets were constructed in a brick building 70 feet by 157 feet, and occupy one-half of the building, leaving room for two more sets. The rated daily capacity of these sets is five million cubic feet of gas each, and results during the month they have been in operation prove that this estimate is very conservative, as high as 94,000 feet of gas having been generated in runs of ten minutes.


Stack Valve
Gas Inlet for Catalyser
Steam inlet for Gas Making
Make Oil Burners
Air Blast
Gas Inlet for Catalyser
Inlet for oil for heating and steam for gas making
Common gas offtake for both shells
Make oil Burners
Secondary Blast

Section of Improved Jones Set.

The economy in the use of oil is probably the most important and valuable feature of the new process. Improvements in the old method reduced the oil used per thousand cubic feet of gas to about nine gallons, and the early experiments with the new process promised a reduction of 8.2 gallons, while the results of the workings of the improved process show that the oil used to make a thousand cubic feet of gas will never exceed seven gallons. It has also been demonstrated that the sets can be heated preparatory to making gas with one-half gallon of oil per thousand feet; about one-third the amount necessary in the old process.

The Improved Jones Process combines economy, efficiency and ease of operation, with the maximum production of gas per foot of floor space occupied. All valves are hydraulically operated, and oil, steam, gas and air control are assembled on convenient floor stands. Meters are provided for steam and air, and the gas output of each machine is recorded by a Venturi meter. Pyrometers indicate the temperature of different parts of the generators, so that the days of guesswork in oil gas making are fast disappearing.

The illustrations show the general arrangement of the sets and the operating tables, also the network of pipe on the mezzanine floor leading to the floor stands above. This arrangement simplifies the operator's control and avoids all confusion resulting from a tangle of pipes, meters and valves within sight of the operator. A more technical description of the process may be found in the paper on Oil Gas prepared for the Pacific Coast Gas Association by Leon B. Jones in 1913.

The Theory of Cold Light.

[Paper by WILDER D. BANCROFT, Professor of Physical Chemistry, Cornell University, Read at a Meeting of the Pittsburgh Academy of Sciences and the Illuminating Engineering Society.]

When opaque substances such as carbon, platinum or earthenware are heated sufficiently they emit light, the quality and intensity of which depends on the temperature and not on the nature of the substance heated. Radiation of this sort is called temperature radiation. An opaque gas would also emit light if heated to a suitable temperature. Iodine vapor, for instance, glows when heated to above 500° C. While this may not be entirely a temperature radiation, it is usually so considered. The law of temperature radiation holds only for opaque substances, which are sometimes called perfect radiators. An absolutely transparent substance would give no temperature radiation. At the end of the eighteenth century Wedgwood showed that heated air is not luminous and subsequent experiments have confirmed this conclusion.

Most artificial light is temperature radiation from solid particles. In the kerosene lamp the light is due to glowing particles of carbon. The difference between the kerosene lamp and the gas jet is that the temperature of the latter is higher. If all the solid particles are burned, as in the Bunsen burner, a so-called non-luminous flame is obtained, even though the temperature is much higher than in the burner with a luminous flame. The brilliancy of the lime light is due to temperature radiation from intensely heated lime. In the Welsbach mantle and in the Nernst lamp mixtures of rare earth oxides are used instead of the calcium oxide of the lime light. There is some question whether the light from the Welsbach mantle is exclusively due to temperature radiation, but it is unnecessary to go into that matter now.

At first, one would suppose that the incandescent lamp would give the most efficient temperature radiation because graphite melts at a higher temperature than any other known substance, and the carbon lamp can be made to give an extraordinary light efficiency, but its life is extremely short under these conditions, because the graphite vaporizes or disintegrates and the filaments break. There has therefore been a systematic search for substances with high melting points and low vapor pressures, producing successively the osmium, the tantalum, and the tungsten lamps. In the nitrogen-filled tungsten lamp the thermal radiation has been cut down, and consequently less power is needed to heat the filament to a given temperature.

While it would be foolish to claim that the limit of efficiency has been reached, it must be remembered that a large number of very able men have been attacking this problem systematically, and that consequently the limit of efficiency is probably being approached. That brings up the question whether light may not be produced in other ways than by temperature radiation, and if so, whether it is possible to produce cold light. The firefly produces cold light, Langley's study of the firefly having shown that it gives about 95% efficiency; meaning that about 95% of the radiations are in the portion of the spectrum visible to the human eye, while only about 5% are in the ultra-red portion of the spectrum or what are popularly called heat rays. The light of the firefly cannot be due to a temperature radiation because the firefly does not burn up. It does not involve life because its abdominal parts can be dried and kept for two years, and at the end of that time the powder will glow if moistened and exposed to oxygen. It is simply an oxidation process. The firefly has the power of secreting a substance which burns with a luminous, cold flame. If one would make in the laboratory the substance that the firefly makes, it would behave in exactly the same way as the natural product.

Under certain circumstances cold light can be produced in the laboratory. Angström has calculated that he gets about 95% light efficiency when he passes a current through nitrogen under 0.1 mm. pressure. The losses at the electrodes and at the walls of the tube cut the working efficiency down to about 8%. From his work it seems probable that the Moore light is not a temperature radiation, but due to chemical reactions.

Phosphorescing substances, such as zinc sulphide, emit light at low temperatures and do not involve temperature radiations. As yet such substances as Balmain's paint, etc., have to be exposed to light before they will emit light. Until some other way of stimulating them is found, they are of more theoretical than practical importance. At present very little is known about the chemical reactions involved, because these substances have been studied chiefly by physicists.

The luminescence of salt flames is of great importance theoretically. By putting different salts into the non-luminous flame of a Bunsen burner different colored flames are obtained; yellow with sodium, pink with lithium or strontium, blue or green with copper. Since the temperature of the flame is about the same in all these cases and since one cannot very well claim selective absorption in each case, it seems certain that the colors of these flames are not due to temperature radiation; and the problem is to find out what does produce the luminescence.

One usually gets the same yellow color with different sodium salts, and is consequently tempted to say that the yellow color is due to the sodium atom heated to a suitable temperature. This is not true, however, because sodium salts emit little or no yellow light in the hydrogen-chlorine flame, even though as hot as the flame of the Bunsen burner. The next assumption is that the yellow color is due in some way to sodium metal and that the metal is present in one flame and not in the other. The presence of free metal in the flame is not impossible. Almost all salts are formed with evolution of heat and consequently will dissociate if the temperature is high enough. It, therefore, becomes a question of fact whether a salt dissociates in a given flame or not. To test this, use has been made of a modification of Deville's hot-cold tube. Cold water was run through a porcelain tube and the chilled tube held in the colored flame. With salts of copper, cadmium, tin, silver, lead, bismuth, zinc, antimony and arsenic in a Bunsen flame, mirrors of the metals were obtained on the tube. With salts of mercury a gray deposit was obtained consisting of drops of mercury. No experiments were made with gold or with the platinum metals. No mirrors of tungsten or molybdenum could be obtained from oxides of these metals in the Bunsen flame, but good mirrors were obtained with the hotter oxyhydrogen flame. From the cooler portions of the oxyhydrogen flame tungsten blue and molybdenum blue were precipitated on the tube. When sulphur dioxide was led into the hydrogen air flame, sulphur was precipated on the tube. No copper was obtained when copper salts were fed into the hydrogen chlorine flame, showing that the amount of metallic copper present in this flame is, at any rate, very much less than in the Bunsen frame. It is not to be expected that mirrors of metallic sodium and potassium would be produced. There is, however, some evidence that the metals are actually precipitated.

It is evident that a number of reactions are taking place simultaneously in a flame colored with a salt. It is now believed that all reactions tend to emit light, and that they all emit light if made to take place very rapidly. It is known that increasing the rapidity of a reaction that emits light increases the intensity of the light without producing much change in the quality. While the vaporized salts are sometimes colored, as in the case of cupric chloride, and may therefore give temperature radiation to some extent, it is clear that most of the light emitted by salt flames is due to chemical reactions and is to be classified as chemiluminescence.

Some progress has been made in determining the reaction corresponding to a given color. The following results were obtained for copper salts in the Bunsen flame:

I. Cuprous ion to cuprous salt = red.
II. Copper to cuprous ion = green.
III. Cuprous ion to cupric salts = blue.

The first conclusion is based on the action of cathode rays on cuprous iodide, the third on the combustion of cuprous chloride in chlorine, and the second on the combustion of copper in oxygen. A number of experiments were made on the rapid reduction of cupric and cuprous salts with sodium and aluminum as reducing agents, but no characteristic luminescence could be obtained, presumably because these reverse reactions were not made to go sufficiently rapid. However that may be, it is clear that reductions play no important part as regards the light emitted by copper salts in the Bunsen flame.

When a solution of cupric chloride in aqueous hydrochloric acid is sprayed into the Bunsen flame, there is a red or violet tip to the flame, and when the flame is burning steadily one can often see a violet sheath around the flame. This is not a true luminescence, though it looks like one. It is merely the color of cupric chloride vapor, and it can be obtained in mass by heating copper in an electric furnace and then running in chlorine, or by volatilizing cupric chloride.

When cupric chloride is sprayed into a hydrogen chlorine flame, or when a mixture of cupric chloride and hydrochloric acid is sprayed into a Bunsen flame, the hydrochloric acid cuts down the dissociation of the cupric chloride and there is a reaction from cuprous ion to cupric salt, but not the reaction from copper to cuprous ion. Consequently the flame is blue and not green. The same result ought to be obtained without the acid if one used a flame the temperature of which was not sufficient to dissociate cupric chloride into free metal and chlorine. The alcohol flame is just on the dividing line. Cupric chloride colors a hot alcohol flame green and a cooled alcohol flame blue.

Since the bulk of the light in salt flames is due to chemical reactions and not to temperature radiation, there is a possibility of duplicating the effect, if one can cause the reactions to take place sufficiently rapidly at low temperatures; in other words, if they are done electrolytically. Some years ago Schluederberg showed that light is emitted when an alternating current is passed through lead electrodes in sulphuric acid. Later, Wilkinson obtained flashes of light with a number of metals as anodes, using direct current. Owing to film formation, the light could only be seen for an instant. By pressing a tooth brush against a rotating anode, it is possible to remove the film as it gets too thick and thus to obtain light continuously for ten minutes, for instance. So far we have not been able to obtain an electrolytic flame with copper which could be shown to a large audience, but we can do it readily with mercury.

When mercurous bromide or mercury is burned in bromine an orange light is emitted. When mercurous or mercuric bromide is exposed to the cathode rays a similar orange light is obtained. When mercury is made anode in a cold, fairly concentrated, potassium bromide solution (25% for instance) with an anode current density of about 2 amperes per square decimeter, the mercury first becomes coated with a film of bromide and then appears to glow with a brilliant orange light. This will last for at least 10 minutes, at the end of which time the film will have become so thick as to prevent the light being seen. The light can be obtained at as low a voltage as 3 volts, but the intensity is then very low. With increasing voltage—or really with increasing current density—the intensity of the light increases, the upper limit coming when visible sparking takes place. The phenomenon is shown very well with a voltage of 24-28 volts.

This is not cold light. It is not even a very efficient light. The importance of it lies in the fact that it is a striking illustration of the principle that reactions emit light and that a high temperature is not essential. To obtain cold light one must find a reaction which can be made to go rapidly, which absorbs heat or evolves but a small amount of heat, and which has a high conversion factor for light. A number of other requirements come in, if it be stipulated that the light shall be suitable for commercial purposes. There is no immediate prospect of the present methods of lighting being superseded; but the theoretical feasibility of cold light and the general conditions under which it is to be obtained have been demonstrated.

L. C. BRADLEY, assistant district manager of the Stone & Webster management association, with headquarters in Dallas, Tex., will move his office to Houston on July 10, where it will be permanently located in the Scanlan building. This office is the district headquarters for all the properties in Texas managed by the Stone & Webster Management Association.

Fusible Plugs.

An investigation of fusible boiler plugs by the Bureau of Standards will probably result in new specifications for those employed by the Steamboat Inspection Service, the Ameriean Society of Mechanical Engineèrs and the Interstate Commerce Commission. The investigations indicate that through lack of technical knowledge of the behavior of tin plugs containing relatively small percentages of impurities this safety device is rendered practically valueless in the average boiler.

The fusible boiler plug, in its usual form, consists of a brass or bronze casing with external pipe thread, filled from end to end with a fusible metal or composition that has a melting point around 480° F. These plugs are fitted into the boiler, in the flues, tubes or combustion chamber where they are about an inch or more above the dangerous low water level, with one end on the fire and one end on the water side. As long as the water level in the boiler is above the plug, its temperature remains below the melting point of the filling, but if the water falls much below the plug there is opportunity for local overheating, and the filling of the plug melts and is blown out. Tin is the metal used almost exclusively as the fusible constituent, and is required by all standard specifications, having a low melting point, being only slightly corrodible and easily obtained pure. Its desirability in this respect is to some extent called in question by the investigation.

The inquiry was undertaken to determine why plugs have been found intact in boilers that have exploded as the result of low water. The plug in one case was sawed longitudinally and found to contain only traces of the original tin, imbedded in a greenish matrix that was proven to be largely tin oxide, and with a melting point about 2900° F. The oxide was distributed in such a form that it held the pressure and would not have melted until the bronze of the casing and even the steel of the boiler had melted. It is obvious from this that such a plug is an actual source of danger instead of safety.

A question thereupon arose as to the source of the tin oxide; whether it was there originally or had been formed by corrosion, and if the latter is caused by operating conditions of the boilers, or is it a fault in the method of manufacture? About 1050 plugs were subsequently examined, of which about 100 had been in service varying from 4 to 12 months, and representing the products of 105 manufacturers. After these plugs were tested for dimensions they were sawed axially and the filling observed. Particular attention was paid to the presence of oxide, scoriae, blow holes and other faults originating in the manufacture of the plugs, or during service.

The specifications of these plugs called for a bore "tapering evenly from end to end of filling." Nearly 10% of the 1,050 failed to comply with this specification. Some contained fillings with ribs projecting into the casing, others had threaded fillings, while others were not tapered along their entire length. In a few cases the bore of the casing had not been machined after casting and the filling could be easily dislodged.

The Bureau's investigation demonstrated that the correct design of a plug is of more importance than supposed. Owing to the difference in the coefficients of expansion of the casing and the filling and to the existence of an allotropic change in tin at 320° F., there will be interplay between casing and filling unless the design is such as to support the filling rigidiy in the casing. A smooth bore "tapering evenly from end to end" is, therefore, not to be recommended, and it is noted that the Steamboat Inspection Service has recently allowed a fine inside thread. In the opinion of the Bureau's experts, however, there is no reason why a thread should be allowed and not other types of recess or projecting shoulder.

It appears that the failures of tin plugs are of two types; first, those in which the oxide forms as an interlocking "network" throughout the tin of the filling; and second, those in which the oxide forms as a solid, hard mass at the fire end of the plug. An explanation of the formation of the network was the presence of from 0.3% to 4.0% of zinc. Such a filling underwent a progressive change, becoming no longer fusible below a temperature sufficient to fuse the plates of the boiler. The lowest zinc content found in any of the plugs that displayed the network oxidation was 0.3%. Further, although zinc is, because of its greater corrodibility, most dangerous when coalesced into a network structure such as is developed upon heating to about 180° C., other metals that do not form solid solution with tin may also cause the formation of this structure, as, for instance, lead. It seems then that the tin must be free as possible from zinc and lead. This state-

ment is made notwithstanding the apparent fact that if zinc is present a small content of lead is beneficial; it is better to prevent oxidation by using pure tin than to use lead with tin containing zinc."

"Any specification, such as that of the Interstate Commerce Commission, that ignores the purity of the tin, is insuficient. The specifications of the American Society of Mechanical Engineers seem to limit the quality by calling for tin of a melting point between 400° and 500° F., but in reality this specification has no significance from the standpoint of purity since it would admit tin containing as much as 65% of lead or 15% of zinc. Manifestly such a specification is worthless. The Steamboat Inspection Service requires at present Banca tin, but proposes to call for 'tin 99.7% pure, containing not more than 0.1% zinc.'"

Oil-Mixed Concrete for Damp Proofing.

From extensive laboratory and service tests, the Department of Agriculture has secured results which appear to establish the value of oil-mixed concrete for damp-proof construction. Detailed results of these tests are contained in bulletin No. 230 of the department, entitled "Oil-Mixed Portland Cement Concrete." Briefly summarized, the conclusions are that the mixture of certain mineral oils in proportions not to exceed 10% of cement used, does not lessen the tensile strength of mortar; that the decrease in the compressive strength is not serious; that concrete mixed with oil takes perhaps twice as long to set hard, but that the increase in strength is nearly as rapid as in the plain concrete. Oil does not make the concrete impervious to heavy water pressure, but does make it practically non-absorbent under low heads.

The oil-mixed concrete seems particularly useful in basement floors, watering troughs, cisters, barns, silos and in all parts of concrete structures that are to be made damp-proof.

The oil should not exceed 10% of the weight of the cement and generally 5% is all that is necessary. The sand and cement should be first mixed into a stiff mortar, to which is added the correct amount of oil, and the mass again mixed until all traces of oil have disappeared. The oil must be thoroughly incorporated in the mixture, and the time of mixing should be practically double that when the oil is not used.

The kind of oil is important and the following specifications are suggested:

(1) The oil shall be a fluid product with no admixture of fatty or vegetable oils.

(2) It shall have a specific gravity not greater than 0.945 at 25° C.

(3) It shall show a flash point of not less than 150° C. by the closed-cup method.

(4) When 240 cc. of the oil is heated in an Engler viscosimeter to 50° C., and maintained at that temperature for at least 3 minutes, the first 100 cc. which flows out shall show a specific viscosity of not less than 15 nor more than 30.

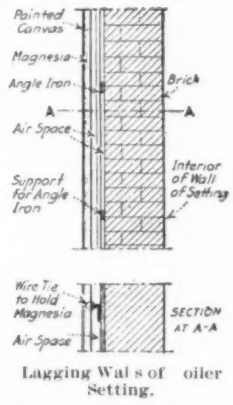
(5) When one part of the oil is shaken with two parts of hundredth normal caustic soda there should be no emulsification, and the two components shall rapidly separate in distinct layers.

For practical use the addition of oil will be found particularly useful in the construction of basement floors and walls. Many of these are continually damp and such a condition may be remedied by the application of an oil-mixed mortar coat to the old surface. A mortar composed of one part of cement and two parts sand, and containing 5% of oil should be sufficiently non-absorbent for this purpose. Watering troughs and cisterns of oil-mixed concrete should prove of considerable practical value in the conservation of water. In barns where oil-mixed concrete is used the interior will be noticeably drier than when ordinary concrete is used. Owing to their durability, cleanliness and resistance to fire, concrete buildings are becoming more and more popular, but they suffer from the disadvantage that during a long beating rain the side walls absorb moisture, which ultimately penetrates into the interior. The addition of 5% oil in the concrete used in the side walls obviates this objection. Barn floors can be constructed in the same way with advantage. A damp-proof floor is warmer because of the lack of evaporation from its surface, and it is also more sanitary than an ordinary concrete floor because of its non-absorbent character.

There are, of course, any number of other types of buildings and structures of all sorts in which oil-mixed concrete may be used advantageously, or, if this is not necessary, a coat of oil-mixed mortar may be applied effectively.

New Methods and Appliances.

LAGGING FURNACE WALLS TO STOP HEAT LOSS.—Tests conducted in the generating station of the Springfield (O.) Light, Heat and Power Company, showed 70° F. difference in temperature between the air close to the brick wall of the boiler settings and air in the same horizontal plane out in the middle of the aisle space. Upon the discovery of this considerable loss of heat by radiation, the company decided that a lagging on the exterior of the boiler setting walls might pay for itself.



Lagging Wal s of oiler Setting.

It is known that a 2" coat of magnesia lagging on a live steam pipe under ordinary operating conditions will reduce the surface temperature about 165° F., and it was with this fact in mind that the boiler lagging shown herewith was designed. Directly against the brick, supports for vertical angle irons are to be placed; the magnesia to be supported against the angle irons and held in position by tie wires, and over the magnesia a heavy layer of canvas will be stretched and these painted. With this sort of lagging there will be two dead-air spaces and a layer of magnesia, to prevent the escape of heat. The painted canvas, it is thought, will better draft conditions by preventing any air from entering through the magnesia and brick.

SUBSTITUTING LEAD-COATED SHEETS FOR GALVANIZED.—Sheet manufacturers have been giving the subject of a substitute for galvanized sheets much consideration, because of the high price of spelter, and several have concluded that the best solution of the problem is the manufacture of long ternes plates. A number of them that have ceased to make galvanized sheets have already placed orders for outfits for coating long terms, and others are placing lead-coated sheets on the market. The general adoption of substitutes for galvanized sheets will mean a large increase in the consumption of lead and will have a tendency to cause a further advance in the price of lead and higher prices for the lead-coated sheets and ternes. While some good business has already been booked in long terne plates as a substitute for galvanized sheets, the trade generally appears to be going slow in this direction, and so far most consumers prefer paying the high prices for galvanized sheets rather than trying to substitute the other at considerably lower prices.

WELLS MORE THAN A MILE DEEP.—The deepest well in the world is in Upper Silesia, in the German Empire, a diamond-drill hole in a coal field 7,350 feet deep. A well in the United States which may go deeper, according to the United States Geological Survey, is 4 miles northwest of McDonald, Pa. This well, which is being sunk to the Medina sandstone—a bed that elsewhere contains oil and gas—is now 7,174 feet deep. Some gas and oil were struck in the upper part of the well. Between the depths of 6,830 and 7,100 feet, rocks bearing rock salt and salt water were encountered. These are regarded as of Salina age, the same as those carrying rock salt in Western New York. The temperature in this well at the depth of 6,775 feet, as recently determined with great accuracy, is 145.8° Fahrenheit.

At Derrick City, McKean County, Pa., there is a well 5,820 feet deep, probably the second deepest well in the United States. Another deep well is on Slaughter Creek, Kanawha County, W. Va.; it is 5,595 feet deep. It penetrated a sandstone at 5,030 to 5,050 feet, and from this depth to the bottom, a distance of 545 feet, the well is in limestone. Near West Elizabeth, Pa., there is another well 5,575 feet, penetrating into a black shale. Another deep well being drilled at Gaines, Pa., has reached a depth of 5,500 feet.

STORING STEAM AT THE ENGINE.—Large receivers and separators were placed near the throttles of the recipracating engines recently installed in the power house of a Western mining company, while the boiler drums at the plant were made unusually small, as the company's engineer declared that the proper place to store reserve steam is at the engine throttle. The receiver capacity at each engine is practically four times the cylinder capacity, and the reservoir permits the use of smaller steam piping, thereby reducing heat losses and establishing at the same time a reserve supply of dry steam immediately at the engine throttle where it is needed under the condition of an engine engaged in mine hoistlng.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE United Gas Improvement Company has continued its display rooms at Eleventh and Market streets, and now devotes the entire first floor of its main building at Broad and Arch streets, with a large part of the adjoining Fidelity Building, to the display of domestic gas appliances. This space is the largest in the world devoted to such a purpose. The industrial Department and the division offices of the New Business Department will occupy three floors of the new Metzger Building at 13th and Cherry streets; where a complete Industrial demonstrating equipment will be installed.

H. W. DUNCAN superintendent of the Northern Indiana Gas and Electric Company, Plymouth, Ind., who has almost doubled the business in five years, has been engaged as superintendent of the Waxahachie (Tex.) Gas Company, and will leave at once to assume his new duties.

THE Public Service Corporation of New Jersey has obtained from Chancellor Walker a writ of error entitling the company to an appeal to the United States Supreme Court from a recent ruling of the Public Utilities Commission directing the corporation to sell gas at 90 cents.

ABOUT 300 employees of the Lynn (Mass.) Gas and Electric Company attended the "smoke talk" in their club rooms and enjoyed a most pleasant evening. An elaborate program consisting of song, story, dancing and sleight of hand performances had been arranged. Harry Tarbox served as master of ceremonies. John Heffernan made a hit singing "When I Dream of Old Erin, I'm Dreaming of You." Billy O'Connor kept the gathering in good humor with funny stories and songs. Little Micky Flynn, who was introduced as "Lynn's juvenile Caruso," rendered several ballads and was loudly encored. Bannon and Talimino in songs and dances were good, as was John Sweet in dramatic recitations. Tom Diamond, one of the most popular employees of the company, brought his fiddle along and played an Irish breakdown in such a manner that Barney Fitzpatrick and John Herlihy were unable to control themselves and danced a nifty Irish jig. Refreshments were served. The following committee was in charge: Michael Moran, chairman; Joseph Clark, Angus Campbell, Marvin Schanks, George W. Leadbetter, Frank Chase and Peter Mayo.

A. C. SWAIN, a gas engineer well known in the West, died in Berkeley, Cal., some weeks ago, at 60 years of age. He built the Equitable Light and Power Works, of San Francisco, 15 years ago, and following that spent 11 years in the east, building and reconstructing gas plants. At Plymouth, Pa., he built a chain of fourteen plants, at St. John, New Brunswick, he reconstructed a chain of works, and at Fulton, N. Y., did the same work. In Chicago he constructed a chain of seven or eight plants for the Rufus S. Dawes Company, and for sevsral years was associated with the Sunderland firm, 49 Wall street, New York city. Four years ago he returned to the coast and had since then made his home in Berkeley.

THE Philadelphia Section, "Gas Meeters," at the June meeting, elected these officers: Chairman, R. J. Rolston; Commissioners, J. B. Jones, George Philler, Jr.; Secretary, Wallace G. Murfit.

AN improved lighting service for University Parkway, from Stony Run to the northern city limits of Baltimore, Md., is being installed by Lighting Superintendent Mohr at the suggestion of Mayor Preston. He is placing 73 ornamental gas lamps on both sides of the parkway.

THE Sheriff is looking for a talkative young man who has been canvassing just outside of Detroit, in Greenfield township, for consumers for the gas company and asking for a $5 deposit for installation. According to officials of the gas company the man is a fraud, and the Sheriff has issued a warning to residents of that section.

JOHN HOWARD, who had been foreman of the plant of the Milwaukee Gas Light Company for 25 years, is dead. He had been ill for five days with pneumonia. Mr. Howard was born in County Cork, Ireland, and settled in Milwaukee immediately after arriving in this country. He was 55 years old, and a member of the Ancient Order of Hibernians and the Catholic Knights of Wisconsin.

THE San Antonio (Tex.) Gas and Electric Company dates back to 1858. The original plant, as compared with the improvements of to-day, was extremely primitive, but it was the endeavor of the promoters to give the people a more convenient form of lighting their homes and stores than the kerosene lamp and tallow dip, the only methods employed at that time. After the civil war the plant met formidable competition, two new companies being started. Later on, all three of the plants installed electric machinery, giving the city both gas and electric facilities. In 1890 the San Antonio Gas and Electric Company brought all three companies together, and at once proceeded to construct a gas and electric plant that would be a credit to any city of this size in the country. The company now has about 168 miles of mains and the system is constantly being extended to new territory. During the last few months the mains have been extended to Alamo Heights at heavy expense.

THE rates for natural gas established by the State Commission for the Central Indiana Gas Company, effective July 1st, are as follows:

First	1,000	cubic feet	@	80c.,	discount	10c.,	net 70c.
Next	1,000	"	"	70c.,	"	10c.,	" 60c.
"	1,000	"	"	65c.,	"	10c.,	" 55c.
"	1,000	"	"	60c.,	"	10c.,	" 50c.
"	1,000	"	"	50c.,	"	10c.,	" 40c.
"	5,000	"	"	45c.,	"	10c.,	" 35c.
All over	10,000	"	"	30c.,	"	0c.,	" 20c.
Minimum bill				80c.,	"	10c.,	" 70c.

The towns effected are: Muncie, Riverside, Normal City, Alexandria, Anderson, Elwood, Fairmount, Marion and Hartford City. The old rates were:

First	5,000	cubic feet	@	50c.,	discount	10c,,	net 40c.
Next	95,000	"	"	45c.,	"	10c.,	" 35c.
All over	100,000	"	"	30c.,	"	0c.,	" 30c.

Minimum bill, 50c.

THE Public Service Gas Company may lay mains in South River, N. J. The company is willing to pipe every street in the borough except a few on the outskirts of the town on which there are no residents who would sign as prospective users. Mayor Fee and the Council are anxious to have gas installed for domestic use, but under no circumstances will they grant a permit to the company to sell it for lighting purposes, as this would open up opposition to the borough's municipal electric light system. South River has been looking forward to the installation of gas in the borough for ten years, and it appears now as though the wishes of the people would be gratified.

THE Massachusetts Board of Gas and Electric Light Commissioners announce a hearing to determine whether or not in its opinion there are in the market practical safety gas cocks, valves, or other appliances, by means of which the supply of gas to a building can be shut off automatically or manually outside of the building in case of fire or emergency, the approximate or probable cost of installing and maintaining such appliances, and the conclusion of the board as to the feasibility and desirability of requiring by general law the use of such appliances.

THE first meeting of the Board of Directors of the Beverly Gas and Electric Company in the new building at the corner of Cabot and Hale streets was held last week. Routine business was transacted, and after the session President Sidney W. Winslow and the other directors made an official inspection of the new offices and expressed satisfaction with the work done, which has given the company one of the finest store and office buildings in the country.

FITCHBURG (Mass.) consumers have gas at $1, beginning July 1, the old price having been $1.20 gross and $1.10 net. In a statement to the local papers C. R. Hayes, manager, says: "The consumption of gas has increased greatly since the Tenney interests secured control of the Fitchburg Gas and Electric Light Company and installed up-to-the-minute machinery and appliances. The efficient methods of handling all classes of work which have been adopted by the Tenney people have caused Tenney Service to become a well established standard for public service companies in their relations with the public. It is especially significant that the

latest reduction in the price of gas was granted in spite of increased cost of material and labor, as well as other factors which enter into the cost of production. The officials of the company have faith in Fitchburg as a growing community, and those interested in the welfare of the company financially are backing the judgment of the officials by supplying the capital necessary for extensions."

THE Consolidated Gas, Electric Light and Power Company has agreed to a compromise with the Maryland Commission, and on January 1st, 1916, will reduce the price of gas in Baltimore from 80 cents to 75 cents, and accept the standard of 600 B. T. U.

THE Domestic Science lectures given by the Kennebec Gas and Fuel Company, Waterville, Me., included the preparation and serving of luncheon menus, and were thoroughly appreciated by the ladies of the city as evidenced by their large attendance.

THE last news from Kalamazoo, Mich., is that Mr. Newbigging has set the figures he thinks right for the city to pay the Michigan Light Company for its main system; that Prof. Bemis has managed to get called into the controversy, and that a special election is to be called to submit to the people the proposed issue of bonds for gas and electric municipal systems. One issue will provide for the city owning and operating its own gas plant to cost approximately $975,000. The other will cover the plan to extend the electric lighting plant to furnish commercial power and light to the entire city. The cost of extending the plant has not yet been determined by electrical experts in charge. The council's committee has offered the gas company $821,150 for its holdings, 10% more than William Newbigging advised the aldermen to offer. Should the company fail to agree on terms, the gas bond issue will be drafted providing for the erection of an entire new plant and distributing system, to cost in the neighborhood of $975,000 complete.

OFFICERS of the Newark (N. J.) New Business Club of the Public Service Gas Company were elected during an outing in Heidelberg Park, Maplewood, at which athletic games were held and prizes awarded. The officers are: President, Alfred J. Phillips; vice-president, Alfred F. Hacker; secretary, N. P. Van Brunt; treasurer, W. K. Ferris; and trustees, George May and Herman N. Sklar.

THE Western Gas Construction Company, Ft. Wayne, Ind., has received the contract for erecting the new holder at Ft. Collins, Col., for the Poudre Valley Gas Company.

THE Gratiot County Gas Company is now supplying four towns—Alma, St. Louis, Ithica, and Breckenridge, Mich. The mains were completed and gas turned on the last-named about two weeks ago.

THE Town Board of North Hempstead, N. Y., has divided the street-lighting contract for the town between the electric light and the gas companies. The Public Service Corporation of Long Island was awarded the contract to furnish gas lights in Great Neck, Westbury, and Mineola; the Nassau Light and Power Company the contract to furnish electric lights for the streets of Port Washington, Manhasset, Roslyn, and East Williaston The gas company will charge $30 per year for 90-candlepower lights, while the electric company has a sliding scale running from $15 for 32-candle to $27 for 100-candle-power. Great Neck was unanimous for gas. The taxpayers there said that the gas company informed them that unless it secured the street-lighting contract it would be unable to extend its mains in that village. Many of the real estate dealers claimed that it was impossible to sell or rent houses because there was no gas. There are about 1,600 street lights in the town of North Hempstead outside of incorporated villages.

CHESLEY F. STEVENS, for several years superintendent of the gas department of the Woonsocket Division of the Blackstone Valley Gas and Electric Company, severed his connection with that company on July 1st and was succeeded by Ralph W. Perkins, who has been foreman of the jobbing department. F. J. Nason, who comes from Haverhill, Mass., will assume the duties formerly performed by Mr. Perkins, in addition to being foreman of the street-main department.

UTILITIES COMMISSION NEWS.

BONDS TO REPLACE ADVANCES.—The Maine Commission has rendered a decision on the application of the Bangor Power Company for authority to issue securities, and while following decisions in New York cases to the effect that a corporation cannot issue bonds to reimburse itself for money previously taken from the treasury, the Commission felt that the rules should not be applied without qualification as to conditions. The decision says in part:

"If a utility expends moneys from its surplus for the acquisition of new properties, or for extensions and betterments, which it apparently does not then need as working capital, with no present intention of replacing it except from earnings, and later, under changed conditions, seeks to restore it in this manner, we doubt very much if authority legally could be granted. When, however, during the course of such acquisition or construction, it uses available funds not immediately required for current normal expenses and charges, in the expectation of reimbursing its treasury when the work is completed, or when such funds are required for such current expenses, it amounts in effect to a temporary deflection or borrowing of money. It does not seem that such a course is inconsistent with a fair construction of the statute. To hold otherwise would impose a hardship upon the corporation and ultimately upon the public who must pay the bills, because it would force the corporation to borrow and pay interest as it went along while funds temporarily available were lying idle in the treasury.

"The petitioner had executed its mortgage in 1911, under which it was entitled to receive from the trustee at any time bonds to the amount of $1,060,000. The balance of the authorized amount, $1,440,000, was to be certified and delivered 'from time to time to reimburse the mortgagor company for the actual cost of extensions', etc., 'to an amount in face value of such bonds not to exceed 85% of such actual cost.' It has been the policy of the corporation to proceed with such work and from time to time to take such amount of bonds as it might under that provision. It had so taken down $192,000 before the present act became operative. It did the work for which the present issue is sought during the first six months of 1914. We think that the case clearly shows that the petitioner proceeded in good faith in the expectation that the proceeds from the sale of these bonds were to be made available to restore to the treasury expenses temporarily made to save unnecessary interest charges which would have been incurred by making temporary loans as the work progressed. We find that the sum of the capital to be secured by the issue of said bonds is required in good faith for purposes enumerated in Section 35, Chapter 125. Public Laws of 1913."

NATURAL GAS COMPETITION.—The Pennsylvania Commission in approving a franchise ordinance between the People's Natural Gas Company and the Borough of Juniata declared that "no company has the right to expect a commission to protect it against the competition of a product which can be supplied at less than one-half the cost of another product and answer the same purpose."

The borough of Juniata approved a franchise giving the People's Natural Gas Company rights of supplying natural gas for fuel and lighting purposes for a term of 40 years, but providing that it shall not distribute manufactured gas until such time as the supply is no longer sufficient to give adequate service of natural gas.

A protest against the approval of the ordinance was filed by the Altoona Gas Light and Fuel Company, which manufactures and sells artificial gas in the same territory, contending that it should be protected from competition, but the commission finds that no decisions go so far as to say that an artificial gas company should be protected in its field from the competition of a natural gas company.

Should the People's Natural Gas Company desire to manufacture and sell artificial gas, it will be necessary to obtain the consent of the commission.

INTEREST ON DEPOSITS STOPS.—The District of Columbia Commission has ruled that interest need not be paid on a deposit left with a company by a customer after the closing of his account. The ruling was made with the understanding that the company shall place on all final bills the following notice: "Please call for deposit if one has been made."

Members of the commission have assigned to themselves separate classes of subjects for consideration. Chairman Charles W. Kutz will take up matters of engineering valuation and rates. Commissioner Brownlow will consider cases relating to jurisdiction, capitalization, financial operations and court proceedings. To Commissioner Newman service and accident cases will be referred.

Financial Notes.

THE WORCESTER (Mass.) GAS LIGHT COMPANY, capitalized at $1,400,000, is to float a $1,000,000 bond issue to pay for improvements that have been made the past year or two and which are to continue through this year, the approximate cost of which will not be far from the amount of the bond issue. President Barnum says the improvements that have been made which are the reason for the bond issue, consist of the construction of a new gasholder, the largest and most expensive of the group at the Quinsigamond avenue works, the installation of a coal gas generating plant and other machinery at the plant, in addition to the laying of many miles of new and larger mains in the outlying section of Worcester this year.

THE May earnings of the COMMONWEALTH POWER, RAILWAY AND LIGHT COMPANY were just about the same as May last year. The earnings were: $1,108,008, an increase of 0.16%; net $586,395, an increase of 0.18%, and balance above charges and preferred dividends, $82,293, a decrease of about $14,000, or 15.04%. The power and gas earnings showed a substantial gain for the month, but the street railway earnings were off, due to unfavorable weather and jitney competition. For the twelve months ending with May the gross was $14,017,928, net $7,291,944, and balance above charges and preferred dividends $1,243,286.

AMERICAN GAS AND ELECTRIC COMPANY is offering at 97½ and interest an additional $500,000 of its 6% 100-year debenture bonds dated May 1, 1914, making the total issue now outstanding $1,500,000.

THE OLD COLONY GAS COMPANY has declared a regular quarterly dividend of 1¼% on preferred stock.

THE 35,680 shares of HARTFORD CITY GAS LIGHT COMPANY bought by New England banking houses have been offered for sale by them at $60 for $25 par shares, and about 25,000 shares have already been disposed of. The stock has been paying 12% regular with 2% extra.

THE shares of the CONSOLIDATED GAS, ELECTRIC LIGHT AND POWER COMPANY OF BALTIMORE showed no effect from the announced policy of the company to reduce the price of gas to 75 cents a thousand feet after January 1st. This is a reduction of 5 cents a thousand, and on the present output will mean a possible loss to the company of about $200,000 a year. The claim is made by those who know that the reduction will so increase the consumption of gas, especially for manufacturing and heating purposes, that the amount may be in part made up to the company through this means. Also, it is declared, the policies and economies that will be introduced to meet this lessened cost to consumers may show in the final net earnings. The fact that the change had no effect on the price of the securities is taken as evidence of the confidence investors have in the management.

A CHICAGO banker says: "Returns from public utility corporations since January 1, show a remarkably healthy condition of the electric light and gas industries. While street railroad earnings have been affected to a certain extent by the depression in different lines of manufacturing and in some localities by the jitney cars, such public service corporations as have all three lines of business under one management, have, as a rule, been able to show a small increase in gross and a very comfortable increase in net, the latter due to savings in operating expenses. It is fairly safe to assume that this condition will prevail throughout the calendar year, and that the public utility business will show better results at the end of the year than any other general line of industry."

THE ASSOCIATED GAS AND ELECTRIC COMPANY has declared the regular quarterly dividend of 1½% on the preferred stock, payable July 15.

COLUMBIA GAS AND ELECTRIC COMPANY is asking through the Columbia Trust Company for tenders of its first mortgage 5% bonds dated January 1, 1907, sufficient to exhaust $1,750,000; tenders to be made by August 3. The funds for the purchase of these bonds for the sinking fund came from the exchange of Columbia Gas and Electric's holdings of East Ohio Gas common and preferred stock for 51% of the stock of United Fuel Gas Company owned by Hope Natural Gas Company. In the exchange Columbia Gas and Electric received $1,849,952, and this sum, with the exception of about $100,000 used to reimburse the company for construction expenditures under its mortgage, will be used to retire outstanding first mortgage bonds.

OPERATIONS in Public Utility shares show a broadening tendency. Columbus Gas and Electric last week showed increased strength and rose to 14, but later reacted. American Gas and Electric was active, with sales as high as 94⅛. Cities Service common moved up to 50½ and the preferred crossed 57. Western Power common was firmer, with sales at 13. American Light and Traction was in demand at 320.

PROVIDENCE GAS in late sales sold at $85.25 and at private terms and continues very scarce under $87. The odds and ends of the recent "rights," representing inaction on the part of a few stockholders who could not be reached, will be taken care of very readily. So far as reported, there was no advance trading in the new debentures, but they are offered for sale at $73. The market anticipates a gradually rising scale of values for the debentures.

STOCKHOLDERS OF THE MUNICIPAL GAS COMPANY of New York have been given the privilege of subscribing at par for 1⅜ shares of new stock for every share held, and for ⅝ per share of 5% convertible one-year notes to be issued.

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